**Smarter Science Inquiry: Factors Affecting the Flow Rate of Fluids**

(see p. 214 of Pearson’s *Investigating Science & Technology 8* for a related teacher-initiated inquiry)

**Strand: FLUIDS** (Understanding Matter and Energy)

**Expectations:**

2.5 use scientific inquiry/experimentation skills to identify factors that affect flow rates of various fluids

2.7 use appropriate science and technology vocabulary: *viscosity, density, particle theory*

2.8 use *oral* and *written* form(s) to communicate for purpose (related to scientific inquiry, e.g. creating a scatter plot, writing a conclusion)

**Materials:** boards, vegetable oil, droppers, stopwatch, pencil, different fluids (e.g. molasses, corn syrup, water, juice, motor oil), thermometer, hot plate, large demonstration protractors, plastic surfaces

**Sample Lesson Plan (3 x 40 min classes)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Approx. Time (min)** | | **What the teacher will do** | | **What students will be doing** | **What to look for, ask about** |
| **Day 1** | | | | | |
| 5 | | Share learning goal with students. Reference and revise learning goals as needed.  Based on the initial demonstration, we will be   * making observations * developing a testable question * conducting a scientific inquiry * identifying factors that affect the flow rate of fluids | | Listening.  Think-Pair-Share 🡪 what do the learning goals mean to you? How will you be able to meet the learning goals? |  |
| 20 | | Show equipment.  Demonstrate running oil on the board.  Ask the following questions:   * what is happening/ what did you observe?   Co-construct success criteria for learning goals based on the demonstration.  Sort, add, remove, and/or revise criteria, as needed. | | Listen & observe.  Write observations on sticky notes.  Post and pile sticky notes onto 1st chart of Smarter Science Posters  Think-Pair-Share 🡪 what does a scientist do during an experiment? Share with whole class while teacher or another student records on board/chart paper. | -objective observations using 5 senses (no inferences)  -piling similar observations on the chart  -some example criteria would include: *accurate measurements, proper use of equipment, recording observations*  -prompt to other criteria such as *coming up with a testable question, prediction/hypothesis, etc. This can be added as you proceed through the lesson.* |
| 15 | Demonstrate the use of the Smarter Science posters and complete up to poster #4.   * What are you wondering about? 🡪 come up with “I wonder” questions * Sort questions and focus on the “testable” questions * Use observations to come up with what you can measure/observe (dependent variables) for Poster 2 * Use “I wonder” questions to come up with (independent) variables for Poster 2 * Guide students through Poster 3 and 4 based on sticky notes from Poster 2 | | 🡪 Students write questions on sticky notes and post on Poster 1  Each pair/group completes their own question & prediction or hypothesis.  Whole Group Sharing 🡪 share sample questions & predictions/hypotheses. | | -choose three questions to demonstrate the different types: researchable, testable, and ponderable  -indicate that the class will focus on the “testable” questions in order to meet the stated learning goals.  -some dependent variables include: *time, speed, ...*  -some independent variables include: *type of fluid, temp., angle of board, type (surface) of board, ...*  -prompt students to choose “time” as the dependent variable but they can choose any independent variable based on one of the questions they came up with  -remaining variables become their control variables. Students record these as control variables.   * How does your question relate to any theories you have been studying? Is this incorporated in your prediction/hypothesis? |
| Day 2 | | | | | |
| 40 | Lead discussion on group norms for planning & conducting a lab (e.g. roles such as materials manager, safety, etc.) | | Students organize and set up the lab  Students conduct lab and record  Student groups consolidate their results (analyse, conclude) | | -Appropriate list of materials and equipment.  -Approved procedure before beginning.   * How will you decide on who does what?   -Use of materials and equipment safely and appropriately  -use of a table to record observations   * Do you think you have enough observations to respond to your hypothesis? * Do you need to repeat anything?   -use of graph to analyse  -conclusion statement based on results and responds to hypothesis |
| Day 3 | | | | | |
| 25 | Lead a discussion on the groups’ results from their own inquiries.  Begin to consolidate learning by answering the question “What factors affect the flow rates of fluids and how?” | | Students share their results with the whole class.  Students complete a R.E.R.U.N. Chart. | | -students post their work on chart paper  -students are able to   * identify the main idea of the lab – factors that affect flow rate of fluids * explain the purpose based on their testable question * describe their results based on the lab they conducted |
| 15 | Use the R.E.R.U.N. to assess the learning goals and to guide further instruction. | |  | | -consider   * what are some uncertainties? How will you address this in class? * what did students learn from this lesson? Does this meet the learning goals? |

**Smarter Science Inquiry: Factors Affecting Solubility of a Substance & its Rate of Dissolving**

(see p. 225 of Pearson’s *Investigating Science & Technology 7* for a related teacher-initiated inquiry)

**Strand: PURE SUBSTANCES AND MIXTURES** (Understanding Matter and Energy)

**Expectations:**

2.2 use scientific inquiry/experimentation skills to investigate factors that affect solubility of a substance and the rate at which substances dissolve

2.5 use appropriate science and technology vocabulary: *solution, solute, solvent, soluble, insoluble*

2.6 use *oral* and *written* form(s) to communicate for purpose (related to scientific inquiry, e.g. creating a scatter plot, writing a conclusion)

**Materials:** beaker, sugar cube, water, thermometer, hot plate, ice

*Note*: Some materials may be added based on students’ choice for independent variable (e.g. different solvents other than water)

**Sample Lesson Plan (3 x 40 min classes)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Approx. Time (min)** | | **What the teacher will do** | | **What students will be doing** | **What to look for, ask about** |
| **Day 1** | | | | | |
| 5 | | Share learning goal with students. Reference and revise learning goals as needed.  Based on the initial demonstration, we will be   * making observations * developing a testable question * conducting a scientific inquiry * identifying factors that affect solubility of sugar | | Listening.  Think-Pair-Share 🡪 what do the learning goals mean to you? How will you be able to meet the learning goals? |  |
| 20 | | Show equipment.  Demonstrate by placing sugar cube in beaker of water and time how long it takes to break down.  Ask the following questions:   * what is happening/ what did you observe?   Co-construct success criteria for learning goals based on the demonstration.  Sort, add, remove, and/or revise criteria, as needed. | | Listen & observe.  Write observations on sticky notes.  Post and pile sticky notes onto 1st chart of Smarter Science Posters  Think-Pair-Share 🡪 what does a scientist do during an experiment? Share with whole class while teacher or another student records on board/chart paper. | -objective observations using 5 senses (no inferences)  -piling similar observations on the chart  -some example criteria would include: *accurate measurements, proper use of equipment, recording observations*  -prompt to other criteria such as *coming up with a testable question, prediction/hypothesis, etc. This can be added as you proceed through the lesson.* |
| 15 | Demonstrate the use of the Smarter Science posters and complete up to poster #4.   * What are you wondering about? 🡪 come up with “I wonder” questions * Sort questions and focus on the “testable” questions * Use observations to come up with what you can measure/observe (dependent variables) for Poster 2 * Use “I wonder” questions to come up with (independent) variables for Poster 2 * Guide students through Poster 3 and 4 based on sticky notes from Poster 2 | | 🡪 Students write questions on sticky notes and post on Poster 1  Each pair/group completes their own question & prediction or hypothesis.  Whole Group Sharing 🡪 share sample questions & predictions/hypotheses. | | -choose three questions to demonstrate the different types: researchable, testable, and ponderable  -indicate that the class will focus on the “testable” questions in order to meet the stated learning goals.  -some dependent variables include: *time, speed, ...*  -some independent variables include: *temperature, surface area (e.g. crushed), type of solvent...*  -prompt students to choose “time” as the dependent variable but they can choose any independent variable based on one of the questions they came up with  -remaining variables become their control variables. Students record these as control variables.   * How does your question relate to any theories you have been studying? Is this incorporated in your prediction/hypothesis? |
| Day 2 | | | | | |
| 40 | Lead discussion on group norms for planning & conducting a lab (e.g. roles such as materials manager, safety, etc.) | | Students organize and set up the lab  Students conduct lab and record  Student groups consolidate their results (analyse, conclude) | | -Appropriate list of materials and equipment.  -Approved procedure before beginning.   * How will you decide on who does what?   -Use of materials and equipment safely and appropriately  -use of a table to record observations   * Do you think you have enough observations to respond to your hypothesis? * Do you need to repeat anything?   -use of graph to analyse  -conclusion statement based on results and responds to hypothesis |
| Day 3 | | | | | |
| 25 | Lead a discussion on the groups’ results from their own inquiries.  Begin to consolidate learning by answering the question “What factors affect solubility of a substance and how?” | | Students share their results with the whole class.  Students complete a R.E.R.U.N. Chart. | | -students post their work on chart paper  -students are able to   * identify the main idea of the lab – factors that affect solubility * explain the purpose based on their testable question * describe their results based on the lab they conducted |
| 15 | Use the R.E.R.U.N. to assess the learning goals and to guide further instruction. | |  | | -consider   * what are some uncertainties? How will you address this in class? * what did students learn from this lesson? Does this meet the learning goals? |